

Surveillance of other beta-lactam antibacterials in Emergency Medicine Institute

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Abstract

Background: The use of other beta-lactam antibacterials in the Emergency Medicine Institute (EMI) recorded in the medium 60%, while around the world in hospitals only 15-20% on average, from all yearly antibiotics consumption. That argument represents an important scientific and practical interest for evaluation of other beta-lactam antibacterials.

Material and methods: For this study we used the data of a six-year (2009-2014) period in the EMI and their subdivisions with main consumption of antibiotics which show dynamics of the use of other beta-lactam antibacterials in grams and value indexes.

Results: In EMI, during the evaluated period other beta-lactam antibacterials recorded a stable consumption (Defined Daily Doses, DDD) from 270.8 to 272.6 DDD/1000 or 58.74% of the total in 2014, with an increase of 0.67% and a decrement in septic surgery and orthotrauma (SSOT) departments from 238.6 to 231.54 DDD/1000 or by 2.96%. A sharp decrease registered in intensive care (IC) departments from 1416.54 to 636.78 DDD/1000 or by 55.05%. In the end of the evaluated period IC departments recorded 24861.5 lei per DDD/1000 that was 7.18 times more than the cost of 3460.46 lei registered in SSOT departments and respectively 4.53 times higher than the cost of 5489.7 lei recorded per DDD/1000 in the entire EMI.

Conclusions: We find that in the evaluated period in EMI, the consumption of other beta-lactam antibacterials recorded in medium the similar yearly data, while the same data in some European and Australian hospitals are on average respectively by 2.18 and 1.32 times less.

Key words: other beta-lactam antibacterials, defined daily dose, consumption, rational use, hospitals.

Introduction

Increment of antibiotic resistance and consumption is one of the most serious global threats to the treatment of infectious diseases [1, 2, 3, 4, 5]. In addition as a consequence it results in significant increases in costs and toxicity of newly appeared drugs, antibiotic resistance complicates the quality of therapeutic treatment. Countries and hospitals with the fewest control in antibiotic prescribing have the greatest frequency of resistant organisms, [6] which suggests a causal connection and necessity of antibiotics consumption evaluation. In The United States, 160 million antibiotic prescriptions are written annually for humans; these figures equate to 30 prescriptions and 4.1 kg of antibiotics per 100 persons per year. Such industrialized nations as France, Australia, The United States, Canada, Italy and the United Kingdom have the highest rates of oral antimicrobial prescriptions, ranging from 33 to 16 defined daily doses per 1000 population per day [7, 8]. All around the world in hospitals the use of other beta-lactam antibacterials recorded approximately 15-20%, while in EMI 50-60% of all antibiotics consumption. That situation determined higher attention for this group of anti-infectives for systemic use in medicine [9, 10, 11] including surveillance, stringent use control and rational prescription, supporting the importance of antimicrobial consumption on resistance [12].

The primary aim of the study was to evaluate institutional representative data on other beta-lactam antibacterials utilization, in accordance with the World Health Organization (WHO) requirements, directed to determine the value of Defined Daily Doses (DDD) per 1000 Occupied-Bed Days (DDD/1000) and value cost in the dynamics per total institution and most important departments [13].

Material and methods

For this study we used the data of a six-year (2010-2014) period DDD/1000 consumption of other beta-lactam and penicillin antibiotics in EMI (Emergency Medicine Institute) and their main subdivisions intensive care departments (ICD – reanimation, intensive therapy and intensive neurological “stroke” departments) and SSOTD (septic surgical and septic orthotraumatology departments) [14] which show the dynamics of consumption of anti-infectives for systemic use drugs as classified by Anatomical Therapeutic Chemical (ATC) classification system of World Health Organization (WHO) indicated in grams and value indexes. Statistical, analytical, mathematical, comparative, logical and descriptive were used as the methods of study.

Results and discussion

For determining the number of DDD/1000 we used data about total annual consumption of other beta-lactam antibacterials and the statistics data concerning the number of treated patients (only patients with health insurance and other free treated by the state categories of citizens). The total number of occupied bed/days in the institution was 188762 in 2009, 191556 in 2010, 186246 in 2011, 199816 in 2012, 193019 in 2013 and 187558 in 2014 and respectively for the evaluated departments of EMI: reanimation department (2009 = 3990; 2010 = 6551; 2011 = 6985; 2012 = 9051; 2013 = 7384; 2014 = 7361), intensive therapy department (2010 = 2922; 2011 = 3327; 2012 = 3239; 2013 = 3407; 2014 = 3388), intensive neurological “stroke” department (2013 = 2553; 2014 = 4193), septic surgical department (2009 = 14030; 2010 = 14212; 2011 = 12875; 2012 = 12372; 2013 =

12464; 2014 = 12104), septic orthotraumatology department (2009 = 10664; 2010 = 10017; 2011 = 9540; 2012 = 10178; 2013 = 9701; 2014 = 9535) [15, 16, 17, 18].

Consumption of other beta-lactam antibacterials in EMI is characterized by the use of parenteral (P) and enteral (E) forms of many subgroups with the respective nomenclature of antibiotics as following: the first-generation of cephalosporins (Cefalexinum DDD 2.0E, Cefazolinum DDD 3.0P), the second-generation of cephalosporins (Cefuroximum DDD 0.5E, 3.0P, Cefaclorum DDD 1.0E), the third-generation of cephalosporins (Cefotaximum DDD 4.0P, Ceftazidimum DDD 4.0P, Ceftriaxonum 2.0P, cefixim DDD 0.4E, Cefoperazonum DDD 4.0P, Cefoperazonum + culbactamum DDD 4.0P) and carbapenems (Meropenemum DDD 2.0P, Imipenemum+cilastatinum DDD 2.0P). Total other beta-lactam antibacterials consumption in DDD/1000 during 2009-2014 is shown in figure 1.

From figure 1, it could be observed a total decrease of other beta-lactam antibacterials consumption for all departments. According to the annual medium consumption of all departments of 2701.58 DDD/1000 could be placed as following: first – reanimation department with 970.38 DDD/1000 or 35.92% and a decrease from 1416.54 to 886.7 DDD/1000 or by 37.34%, second – intensive therapy department with 794.95 DDD/1000 or 29.43% and a decrease

crease from 974.67 in 2010 to 597.7 or by 38.68%, third - intensive neurological «stroke» department with 467.76 DDD/1000 or 17.31% and a decrease from 509.6 in 2013 to 425.95 or by 16.42%, fourth - septic surgical department with 237.92 DDD/1000 or 8.81% and a decrease from 310.05 to 187 DDD/1000 and septic orthotraumatology department with 230.57 DDD/1000 or 8.53% and an increase from 167.1 to 276.14 DDD/1000 or by 65.25% on the position number five. In figure 2 the total other beta-lactam antibacterials consumption of parenteral forms in DDD/1000 during 2010-2014 is shown.

In figure 2 parenteral forms of other beta-lactam antibacterials consumption is presented. As it could be observed from figure 1 and 2 the consumption of parenteral forms of other beta-lactam antibacterials in the mean are similar with the total results.

In figure 3 totals DDD/1000 of other beta-lactam antibacterials (enteral forms) consumption during 2009-2014 are shown.

The data from figure 3 shows that in the evaluated period enteral forms of other beta-lactam antibacterials recorded a significant increment from 0.93 to 61.25 DDD/1000 or by 65.86 times in septic orthotraumatology department and from 2.75 to 10.08 DDD/1000 or by 3.67 times in septic surgical department. Other departments

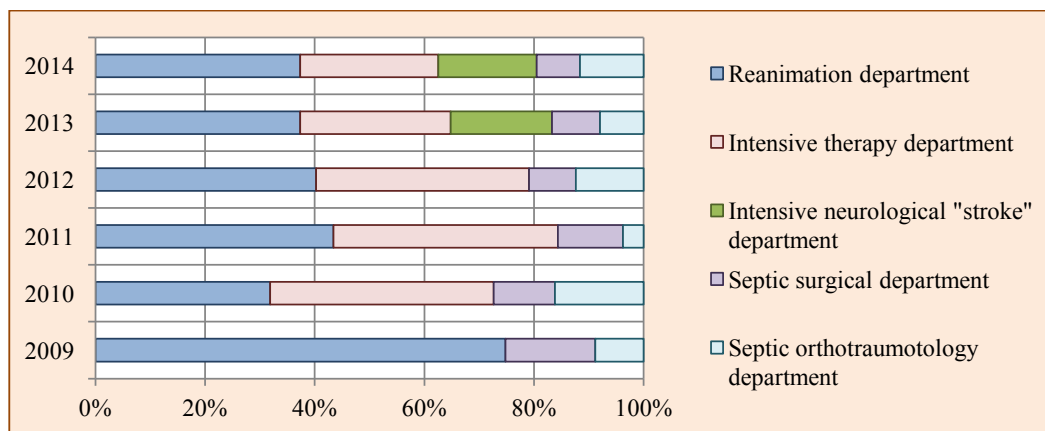


Fig. 1. Total other beta-lactam antibacterials consumption in DDD/1000 during 2009-2014.

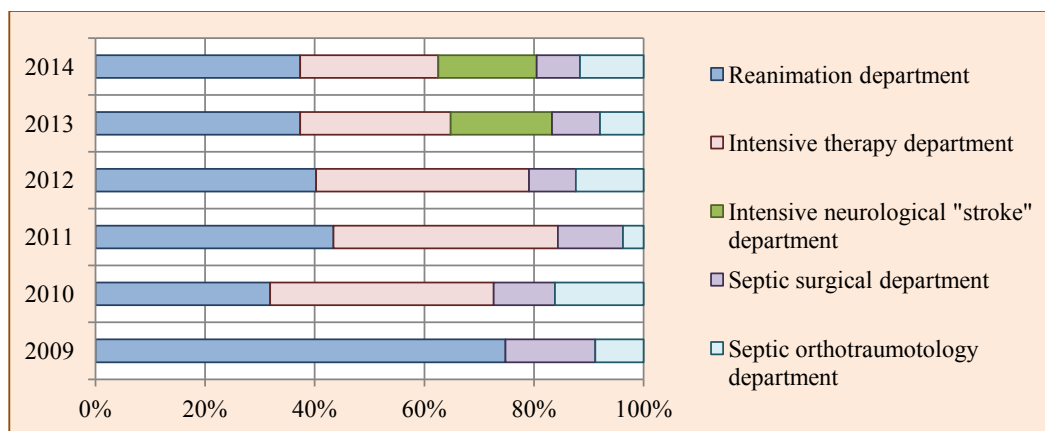


Fig. 2. Total other beta-lactam antibacterials consumption in DDD/1000 (parenteral forms).

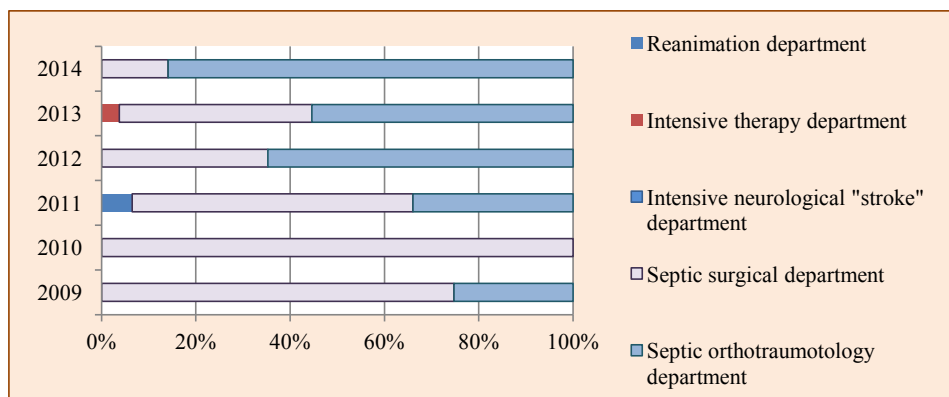


Fig. 3. Total other beta-lactam antibacterials consumption in DDD/1000 (enteral forms).

registered an occasional or didn't record any consumption of this group of antibiotics.

Taking into consideration the situation that in most scientific journals the published data about drugs consumption include the use of them in all intense care hospital unites, we determined the medium consumption of DDD/1000 separately for ICD and SSOTD (septic surgical and septic orthotraumatology departments) of EMI. To determine the medium consumption of DDD/1000 we counted total of DDD/1000 separately for ICD and SSOTD and divided by the number of those departments (3 and respectively 2). The results are shown in table 1.

The data in table 1 shows that in the evaluated period total consumption in ICD departament of other beta-lactam antibacterials decreased from 1416.54 to 636.8 DDD/1000 or by 55.05% and respectively in SSOTD from 238.9 to 231.54 DDD/1000 or by 3.08%. Consumption in ICD departments in 2014 was by 2.75 (636.8:231.54) times more than in SSOTD departments. Total institutional parenteral forms recorded a decrease from 268.6 to 239.3 DDD/1000 or by 10.91% and vice versa enteral forms a significant increase from 2.2 to 25.3 DDD/1000 or by 11.5 times. In table 2 total records of parenteral and enteral forms consumption in EMI are shown.

From table 2 it could be observed that during the evalu-

ated period other beta-lactam antibacterials in EMI recorded a stable consumption from 270.8 to 272.6 DDD/1000 with an increase of 0.67% that in 2014 represents a share of 58.74% of the total. In large acute international public hospitals and other international hospitals, it was registered an increase from 191 to 206.31 DDD/1000 or by 7.91% that in 2014 represented a share of 22.01% of the total of 936.31 DDD/1000. In some hospitals of European countries consumption of this group of drugs recorded a decrease from 144.5 to 125 DDD/1000 or by 13.40% that in 2013 represented a share of 17.60% from the total. In a Single University Hospital a medium consumption in the period from 2001 to 2012 recorded 348.2 DDD/1000 or a share of 54% of the total 644.6 DDD/1000. In French hospitals in 2007 consumption represented 67.7 DDD/1000 or 12.14% from the total of 557.7 DDD/1000 in 27 public teaching hospitals, 36.3 DDD/1000 or 9.77% from the total of 371.5 DDD/1000 in 165 non – teaching public hospitals and 67.3 DDD/1000 or 16.14% from the total of 416.9 DDD/1000 in 158 private hospitals [21]. The same data in 130 US hospitals in 2002-2003 represented 80.3 DDD/1000 or 10.14% from total 792 DDD/1000 [22].

The value cost of other beta-lactam antibacterials use per DDD/1000 in lei is presented in figure 4.

As it could be seen from figure 4, during the evaluated

Table 1

Other beta-lactam antibacterials (parenteral and enteral forms) consumption in DDD/10

Department	Administration	2009	2010	2011	2012	2013	2014
ICD	Parenteral	1416.54	868.73	871.39	812.51	765.97	636.8
	Enteral			1.43		1.47	
	Total	1416.54	868.73	872.1	812.51	766.33	636.78
SSOTD	Parenteral	236.76	326.54	151.47	207.8	212.54	195.87
	Enteral	1.84	0.71	10.25	7.22	18.81	35.67
	Total	238.6	327.25	161.72	215.02	231.35	231.54
Total EMI	Parenteral	268.6	257.6	256.1	213	256.6	239.3
	Enteral	2.2	3.6	16.7	12.4	14.1	25.3
	Total	270.8	261.2	272.7	225.6	270.7	272.6

Table 2

Other beta-lactam antibacterials consumption of DDD/1000 in EMI and some international hospitals

Programs/institutions	2009	2010	2011	2012	2013	2014
Emergency Medicine Institute	270.8	261.2	272.7	225.6	270.7	272.6
Total	662.4	558.2	622.1	542.4	546.9	464.1
Percentage	40.88%	46.79%	43.84%	41.59%	49.5%	58.74%
Large acute Australian pub. hospitals [19]	191	193.1	222	178.4	186.9	206.11
Total	931.8	933.7	946.5	931.6	943.4	936.31
Percentage	20.49%	20.68%	23.45%	19.15%	19.77	22.01%
	2012		2001 - 2012 - 2013		2013	
Single University Hospital [20]			348.2			
NAUSP; SAAUSP [19]			203;186			
DANMAP; SWEDRES; NETHMAP	(192+97):2=144.5				125	
Total	(931+609):2=770		631;945;943		712	
Percentage	18.77%		55%;27%; 22%;29%		17.6%	

period the main value cost of DDD/1000 recorded reanimation department from 40128.3 lei to 33981.3 lei or a decrease by 15.32%, consequently the second position holds intensive therapy department from 35143.5 lei in 2010 to 29271.2 lei or a decrease by 16.71% and thirdly the intensive neurological «stroke» department from 11695 lei in 2013 to 11332 lei or a decrease by 3.10%, followed by septic surgical department from 5495.4 lei to 3330.55 lei or a decrease by 39.39% and the last position was held by septic orthotraumatology department from 3177.24 to 3590.36 lei or an increment by 13%.

In figure 5 the total value cost of other beta-lactam antibacterials in DDD/1000 (parenteral forms) is presented.

The cost of parenteral other beta-lactam antibacterials in DDD/1000 for all departments remains approximately the same comparatively with the total consumption because of low cost of enteral forms for DDD/1000. In figure 6 the value cost of DDD/1000 in lei of other beta-lactam antibacterials enteral forms is shown.

Presented data in chart 6 demonstrates that from the total departments annual costs could be placed as following: the first septic orthotraumatology department with the cost per DDD/1000 from 3.02 lei to 329.52 lei and the second septic surgical department with the cost from 46.73 lei to 72.45 lei per DDD/1000. Other departments because of the lack or very low consumption didn't record at all, or recorded an episodic price per DDD/1000.

To determine the medium cost of DDD/1000 of other beta-lactam antibacterials was counted the total cost of DDD/1000 separately for ICD and SSOTD and divided by the number of those departments (3 and respectively 2).

As it could be seen from table 3 in the evaluated period total medium cost of DDD/1000 for other beta-lactam antibacterials recorded a decrease in ICD departments from 40128.3 lei to 24861.5 lei or by 38.05% and consequently, in SSOTD from 4336.32 lei to 3460.46 lei or by 20.20%. Medium cost of DDD/1000 in SSOTD departments was less than in ICD departments by 8.21 times in 2009 and re-

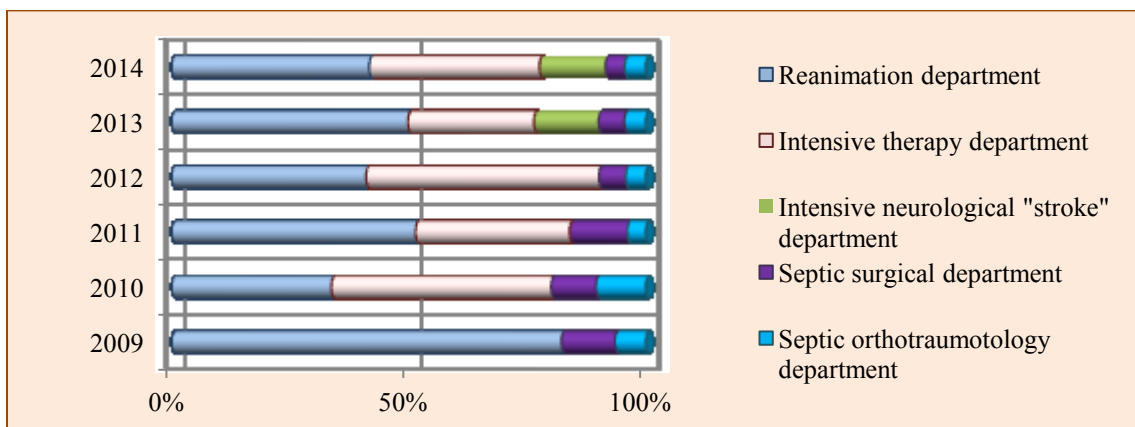


Fig. 4. Total value cost of other beta-lactam antibacterials per DDD/1000 in lei.

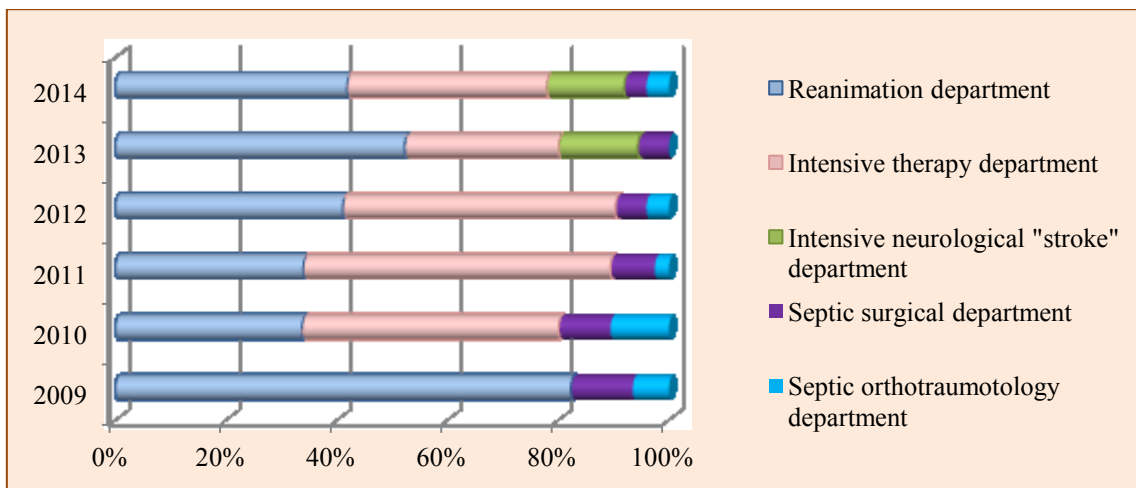


Fig. 5. Value cost of other beta-lactam antibacterials in DDD/1000 of parenteral forms in lei.

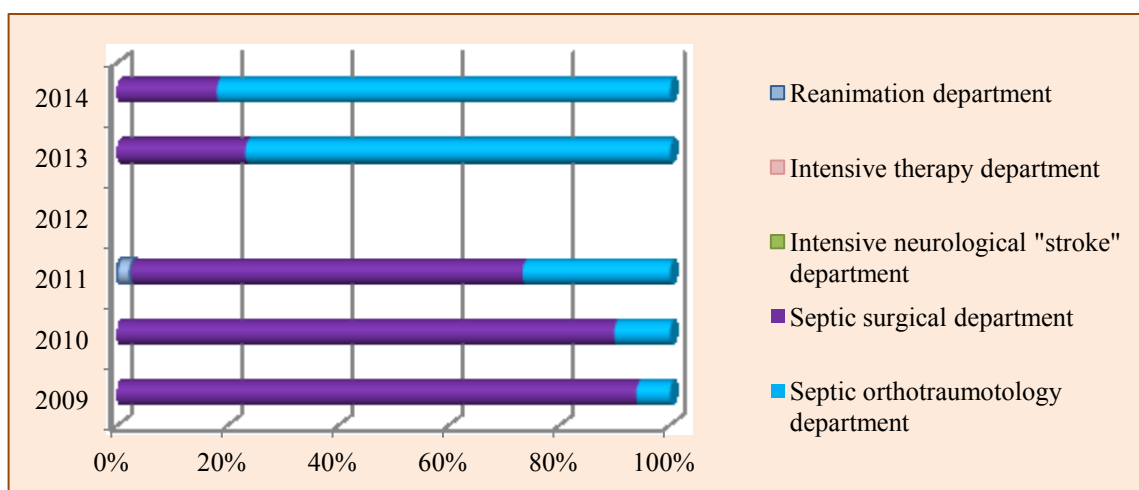


Fig. 6. Value cost of other beta-lactam antibacterials in DDD/1000 (enteral forms) in lei.

Table 3

Medium cost of DDD/1000 in lei of other beta-lactam antibacterials (parenteral and enteral forms) in EMI

Department	Structure of consumption	2009	2010	2011	2012	2013	2014
ICD	Parenteral	40128.3	30354.97	22060.76	26212.93	25760.17	24861.52
	Enteral			1.43		5.83	
	Total	40128.3	30355	22062.2	26212.9	25762.1	24861.5
SSOTD	Parenteral	4311.445	7541.72	4194	2794.39	2290.455	3259.47
	Enteral	24.88	14.31	30.27	67.29	137.86	200.99
	Total	4336.32	7556.03	4224.27	2861.68	4259.34	3460.46
Total EMI	Parenteral	4888.31	5873.17	4942.22	4473.53	5278.44	5368.52
	Enteral	17.18	26.03	103.44	136.74	205.86	121.19
	Total	4905.49	5899.2	5045.66	4610.27	5484.3	5489.7

spectively by 7.18 times in 2014. At the same time, the total institutional cost of DDD/1000 increased from 4905.49 in 2009 to 5489.7 DDD/1000 in 2014 or by 11.91% and was less than medium cost in ICD departments by 4.53 times.

Conclusions

1. In EMI, during the evaluated period the use of other beta-lactam antibacterials recorded a stable consumption in a medium of 272 DDD/1000 in comparison with 125 DDD/1000 in some European hospitals as all as of 206.31 DDD/1000 in Australian acute public hospitals or respectively by 2.18 and 1.32 times less.

2. As to the annual medium consumption of 2701.58 DDD/1000 of all departments places are distributed as following: the first – reanimation department with 970.38 DDD/1000 or 35.92%, the second – intensive therapy department with 794.95 DDD/1000 or 29.43, the third – intensive neurological “stroke” department with 467.76 DDD/1000 or 17.31%, the fourth – septic surgical department with 237.92 DDD/1000 or 8.81% and a decrease from 310.05 to 187 DDD/1000 and septic orthotraumatology department with 230.57 DDD/1000 or 8.53% on the fifth position.

3. Total consumption in ICD departmentals of other beta-lactam antibacterials decreased from 1416.54 to 636.8 DDD/1000 or by 55.05% and respectively in SSOTD from 238.9 to 231.54 DDD/1000 or by only 3.08%. Consumption in ICD departments in 2014 was 2.75 times more than in SSOTD departments.

4. Total medium cost of DDD/1000 for other beta-lactam antibacterials recorded a decrease in ICD departments from 40128.3 to 24861.5 lei or by 38.05% and consequently in SSOTD from 4336.32 to 3460.46 or by 20.20%. At the same time, the total institutional cost of DDD/1000 increased from 4905.49 in 2009 to 5489.7 DDD/1000 in 2014 or by 11.91% and was less than medium cost in ICD departments by 4.53 times.

5. The findings of this study could serve a significant support for hospitals to compare the data concerning antimycotics consumption with the international health care institutions and to optimize in planning necessities as well as to improve rational use of other beta-lactam antibacterials.

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